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James A. K. Miyamoto, P.E.
Deputy Operations Officer
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
Joint Base Pearl Harbor Hickam, HI 96860

Re: Approval in part of Red Hill AOC SOW Deliverable under Sections 6 & 7 - Monitoring Well Installation Work Plan

Dear Mr. Miyamoto:

The U.S. Environmental Protection Agency ("EPA") and Hawaii Department of Health ("DOH"), collectively the "Regulatory Agencies", have reviewed the *Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility* ("MWIWP") submitted by the U.S. Navy ("Navy") and Defense Logistics Agency ("DLA") on April 26, 2016. The Regulatory Agencies are approving the MWIWP in part, pursuant to AOC Sections 7(b)(a) and 7(b)(b) and under the conditions as detailed below. The attachment to this letter provides details on those portions of the MWIWP that are disapproved. The Navy is required to resubmit the MWIWP with corrections within 30 days of their receipt of this letter as per AOC Section 7(b).

Commented [TRR1]: revisions instead of corrections ?

Our purpose in approving this deliverable in part, rather than disapproving it under AOC Section 7(b)(d), is to allow the Navy to move forward in preparing for the new monitoring well installations. We approve the monitoring well locations and proposed drilling methodologies as presented in Sections 3 and 4 of the MWIWP but need the Navy and DLA to address the comments provided in the attachment before we can fully approve the MWIWP. As discussed in our meeting on May 10, 2016 in Honolulu, we are aware that moving forward on the installation of these new wells is of the upmost importance. Therefore we wanted to approve a portion of the MWIWP and trust that this partial approval allows you to begin site preparation work as soon as possible.

The comments from the Regulatory Agencies on the MWIWP are presented in the enclosed attachment to this letter. In addition, we have attached a copy of the MWIWP comment letter received from the Honolulu Board of Water Supply (May 27, 2016). We reviewed their comments and have incorporated many of them in our own comments.

We are available to discuss our comments in more detail. Please contact us if you have any questions. Bob Pallarino can be reached at (415) 947-4128 or at [HYPERLINK "mailto:pallarino.bob@epa.gov"] and Steven Chang can be reached at (808) 586-4226 or at [HYPERLINK "mailto:steven.chang@doh.hawaii.gov"].

Sincerely,

Bob Pallarino
EPA Red Hill Project Coordinator

Steven Chang, P.E.
DOH Red Hill Project Coordinator

Enclosures

cc: Mr. Stephen Turnbull, U.S. Navy

Regulatory Agency Comments on April 29 2016 Monitoring Well Installation Plan, Red Hill Bulk Fuel Storage Facility

Section 1.2.1.3 – Geology and Soils, Page 1-5
Lines 34 - 37:

- This paragraph describes the lava beds in the area of Red Hill as "near horizontal". The Regulatory Agencies believe an acknowledgement of potential of these beds to dip is important. This paragraph should end with a sentence stating that characterizing the strike and dip of the lava flows is important for understanding any product migration in the vadose zone outside of the concrete cocoon of the tanks and will be conducted as part of the overall hydrologic investigation required under Sections 6 & 7 of the AOC SOW.

Page 1-6
Lines 1 to 11:

- The geology and soils section should include a brief discussion of late stage volcanics, e.g. Salt Lake, Caprock formation, and deep stream valley sediments and saprolite ~~which~~ that could act as barriers to groundwater flow.

Section 1.2.1.4 – Groundwater, Page 1-6

- This section should include a paragraph to explain that perched groundwater is present at many locations in the study area, including the basalt and valley fill units in the Red Hill vicinity. The explanation should include what is known about perched water occurrences at Red Hill. Perched water is common in the Halawa Valley near the area where RHMW11 is proposed. During the drilling of RHMW04 a perched water zone was encountered that extended from 85 down to about 130 feet below ground surface. A review of the boring logs for RHMW06 and RHMW07 by the Regulatory Agencies found no mention of perched water, which may have been encountered while drilling these two wells.

Lines 13-17:

- There is some uncertainty as to whether all flow is towards the harbor. The investigation that is beginning with the installation of these monitoring wells will help us understand if there are conditions present in the subsurface that would cause the groundwater to flow in directions other than towards the harbor. The last sentence in the first paragraph (line 17) should make mention of this uncertainty.
- The description of groundwater in this section fails to mention high-level dike confined groundwater.

Lines 25 – 31:

- This paragraph should clarify that while the Caprock aquifer does not extend to the areas in the vicinity of the tanks, it is present in the study area and can influence the flow of groundwater. The Caprock has the potential to divert groundwater flow and other subsurface barriers that may confine flow likely exist within the study area and possibly site area.

Section 1.2.2 – Site History, Page 1-7
Line 37:

- The second paragraph of this section (lines 36-37) refers to the Navy supply well as being downgradient from the USTs. Since the actual downgradient direction in the vicinity of Red Hill has not been adequately defined this sentence should acknowledge the uncertainty, pointing out the importance of this and other investigations to characterize groundwater flow patterns beneath the foot print of the facility. It would be more accurate to state "the assumed down gradient direction" or similar since at this point since we don't know the regional gradient beneath the Facility.
- The blue arrow on the figure entitled "Location Map" (page 21 of the PDF version of the document) is consistent with that shown in USGS publications. However, these publications are based on conceptual models developed decades ago and without the new water level data that has been, and will be acquired by Red Hill investigations. Furthermore, fuel related constituents have been detected in RHMW04 which suggests that at times there is groundwater flow from beneath the Red Hill USTs to the northwest. The arrow should be removed or otherwise modified to reflect the uncertainty.
- The stated distances from USTs to the RHS vary from <2000 to >4000 ft. The distance from the east end of the Red Hill Shaft infiltration gallery to UST 1 is about 1,500 ft, while the distance from west end of the infiltration gallery to UST 20 is about 4,500 ft. Some consistency needs to be used when describing this important parameter. The Regulatory Agencies believe the shortest distance to the infiltration gallery is the greatest concern when considering risk.

Page 1-8
Lines 1 – 7:

- The construction sequence of tanks is not described accurately. Upper domes were constructed first, cavity for tank barrel and bottom blasted and excavated and then barrel and bottom of tank were constructed.

Section 2.2 – Step 2, Identify Study Objectives, Page 2-1
Lines 19-21:

- This section states that one of the principal objectives of the MWIWP is to investigate the site stratigraphy and matrix physical properties. This implies that the MWIWP is the primary plan for developing the conceptual site model for the Red Hill project. The Regulatory Agencies do not agree with this implied objective. The sentence should be revised to state: "The principal objectives of the work proposed in this WP are to install monitoring wells at four locations (shown on Figure 2), ***collect data from the boring of the wells that can be used to better understand the site stratigraphy and matrix physical properties***, and obtain additional groundwater hydrologic data.

Lines 24 -28:

- Section 2.2 of the MWIWP states that the secondary objective of the MWIWP is to evaluate the nature of petroleum product and constituent chemicals in the soil, if present in the vadose and saturated zones underlying and downgradient of the tanks. It further states that the scope of the sampling and analysis program in the MWIWP is limited to the collection of subsurface **soil**, which will only be conducted if soil is encountered at depths below the bottom of the tanks or if contaminated soil is encountered. The Regulatory Agencies require the Navy and DLA to broaden the scope of their sampling and analysis to include any material that is coarse grained sand or smaller grain size, e.g. clay, sands, and clinker zone sand. Any contaminated material of

this type will be sampled and analyzed if it is encountered while drilling regardless of its location.

Section 2.5 – Step 5, Develop the Analytical Approach, Page 2-2
Lines 10 – 11:

- See previous comment to sample all coarse grained sands or smaller sediments with evidence of contamination.
- This section should include a bullet specifically stating that the full length of all cores will be screened with a photoionization detector (PID) regardless of location, i.e. not just below the bottom of the tanks.

Lines 12-13:

- The Navy needs to define the term "significant contamination".
- The intention of this statement is not clear. What actions will the Navy propose to take in the event that significant contamination is detected (once "significant" is defined)?

Section 2.6.2 – Managing Decision Error, Page 2-5
Lines 7-8:

- Leveling the drilling well twice a day during drilling is not sufficient to ensure that well is plumb. With groundwater gradients of approximately 1 ft/mi. it is important that a true vertical depth survey be performed since one of the primary products of Task 5 of the Navy's proposed Scope of Work for the Investigation and Remediation of Releases is characterizing the groundwater flow gradient. The Regulatory Agencies recommend the Navy refer to Honolulu Board of Water Supply (HBWS) well construction details for vertical truth of well. According to the HBWS guidance ***"The level of the drill rig is not the only factor important to ensure drilling a "vertical" borehole. Other factors include bottom-hole weight (bottom-hole drill assembly) and rate of advance, which together should be balanced so the drill bit doesn't deflect as it encounters various basaltic intra flow structures. To accurately determine if each borehole is vertical, the driller should stop and trip-out of the hole and run a gyroscopic alignment survey once a day during drilling."***

Section 3-1 – Monitoring Well Locations, Page 3-1
Lines 34- 35:

- The Navy states that "The proposed well locations (Figure 2) were chosen based on their potential to provide more information about the site's geology and groundwater, and to fill in identified data gaps". Please provide a brief description that specifies the data gaps each well location is intended to address. The description can be included in this paragraph or in the paragraphs describing each well location on pages 3-1 and 3-2.

Section 3-1 – Monitoring Well Locations, Page 3-2
Lines 31-32:

- The text should specify that RHMW11 is intended to provide data to help characterize the geological matrix of ***South*** Halawa Valley.

Figure 3, Geological Cross Section (Transverse)

- What is the basis for the extent of the Valley Fill and Saprolite areas as illustrated in Figure 3? The Navy needs to either provide supporting documentation or references or indicate that the extent of the valley fill depicted on the figure is speculative.
- The description of RHMW11 on page 3-2 states that in order to fully investigate the extent of valley fill or saprolite this well boring may be extended if bedrock is not encountered. Figure 3 should provide an indicator to show the additional depth of RHMW11 in the event that bedrock is not encountered at the target depth.
- Since the facility is the focus of the investigation and RHMW02 is located more or less in the center of the facility, the Regulatory Agencies recommend that the X-axis be centered at RHMW02, which would make it easier to determine lateral distances from the facility.
- The figure incorrectly shows the Halawa Shaft terminating within the valley fill. The Halawa Shaft is actually a horizontal infiltration gallery in the basalt northwest of the valley fill, ~~extends to the basalt underlying the valley fill.~~ The Halawa Shaft is bored into the wall of North Halawa Valley so the depiction of a vertical well located in the center of the valley is inaccurate.
- Remove the word "sporadic" from Note 1 of Figure 3. Note 1 should be revised to, "Existing well logs show a complex subsurface comprised of alternating pahoehoe and a'a lava flow with clinker zones, fractures, and voids."

Figure 4, Longitudinal Cross Section

- Delete the word "Geological" from the title of this figure since no geologic features are depicted in this figure.

Section 3.2.3 – Rock Coring, Page 3-8

Lines 21-22:

- Checks for perched should occur more frequently than at the beginning and end of each workday. Perched groundwater is present at many locations in the study area, including the basalt and valley fill units in the Red Hill vicinity. If only checked at the beginning and end of the day it would be easy to drill through a perched zone without knowing it. When potential perching formations are observed in the rock cores (e.g. highly weather basalt, soil, very massive lava, etc.), the borehole should be checked for standing water.

Figure 5, Cross section of Borehole and Monitoring Well

- Figure 5 indicates that bentonite chips will be used to seal the annular space between the well casing and the borehole. Due to the depth of the wells and the importance of achieving a continuous seal, the Regulatory Agencies require the use of cement grout to seal the entire annular space rather than dry bentonite chips that will need to be hydrated.

Section 3.3 – Subsurface Soil Sampling, Page 3-11

Lines 2-9

- The term "soil" should be replaced with "sediment". See the Regulatory Agencies' comment on the MWIWP Section 2.2 above.

Section 3.4 – Monitoring Well Installation, Page 3-11

Lines 26-29:

- This section should include an explanation and rationale for the Navy's choice of a 30 foot screen length. The appendix to the MWIWP includes a discussion of appropriate screen lengths (page 212 of the PDF, page 16 of 44 of the appendix section entitled "Monitoring Well Installation and Abandonment") stating that screen length should be limited to 5 to 10 feet, however longer intervals may be justified in certain circumstances.

Table 3-3, Existing and Anticipated Borehole and Well Dimensions

- Regarding Monitoring Wells RHMW2254-01 and HDMW 2253-03, since neither of these wells are screened the Navy should determine and provide the depth of the bottom of the well casing for the wells rather than stating "Not Applicable" for the screen interval.

Section 3.5 – Surveying, Page 3-12

Lines 5 – 12:

- The groundwater flow gradient is a regional problem involving the possibility of groundwater flow from the Honolulu Aquifer to the Pearl Harbor Aquifer. Measuring the groundwater flow gradient requires measuring water levels in wells ~~This is particularly important as needs consistent elevation datum to wells~~ from the Moanalua Ridge to well west of North Halawa Valley. The TOC elevation of all wells used in the gradient calculations and in the calibration of the groundwater flow model ~~calibration need to need to~~ be accurately surveyed to a common vertical datum. The Regulatory Agencies strongly recommend the Navy consult with the National Oceanic and Atmospheric Administration's National Geodetic Survey (NOAA NGS) before beginning this work. The Regulatory Agencies can provide the Navy or their contractor a point of contact at NOAA NGS.

Commented [TRR2]: I think a word is missing here

Section 4.3.7 – Dedicated Groundwater Pump System Installation, Page 4-7

Lines 18-19:

- At this time it is the Regulatory Agencies believe that any contamination from Red Hill fuel is near the surface of the water table. The MWIWP proposes to install the bladder pumps such that the intake is located 10 feet below the surface of the water table. This section needs to provide a rationale for choosing this pump intake location. RT - Actually, I don't believe the dissolved contaminants are predominantly near the surface of gw table. I believe these low levels (ppb and single digit ppm for TPH-d in and near MW02 and in 2015 at ODFMWD) are moving as soluble contaminants in gw and therefore move where that gw moves barring mechanical impedance due to the size and physical characteristics of the contaminants.

  Can we leave this comment out of the letter until we receive their written justification for 30' screens? Then I propose directing them to place the intake at mid-screen submerged, or place it at depths of suspected higher permeability (gw flow) based on visual obs of the cores at the screened interval.

  Mark F also discussed the possibility of asking the Navy to do a sampling round with low-flow intake placed high, middle, and low in each well, and separate analyses for TPH-d or something that is actually present…so it would have to be the 2nd monitoring. However, repeated monitoring events would be required to validate any findings from the first event done this way. This is impractical. -RT

Commented [r3]: RBW – Should consider removing this comment. While the proposed screen length and well intake placement differ from what is common for these investigations, there should be no dilution bias in the samples collected. The relative density difference between water saturated with TPH and uncontaminated water (all else be equal) 1.000000005. Over the distances contamination would have to travel, hydrodynamic dispersion would evenly mix the TPH concentration over vertical lengths greater than that of the proposed well screen and pump intake differences.

Section 4.3.9 – Subsurface Soil Sampling, Page 4-7
Lines 34-35:

- This section states that samples will be collected and handled in accordance with Navy procedures as presented in attachments located in the appendix to the MWIWP. These procedures provide a number of options and are generic procedures. The Regulatory Agencies require the Navy to include specific details on soil/sediment collection procedures that will be used at the Red Hill study area, including specifications on the type of sample containers that will be used. These details should also be included in Table 5-1. Lines 35-37:
- Revise the sentence beginning on line 35 to read "*The subsurface soil samples will be inspected for evidence of contamination (visual, olfactory, elevated PID readings) in order to evaluate the potential migration of LNAPL and associated constituents.*"

Section 5, Sample Details, Page 5-1
Table 5-1, Subsurface Soil Sample Details for Monitoring Well Installation WP, RHSF

- For TPH-g, the container type should be listed as "5 gram increment soil/ 40 mL VOA vial". For the preservative type, it should read "3x 40-5 ml MeOH preserved <6°c". We request three 40 mL vials in order to accommodate duplicate runs on new wells for TPH-g and one spare one just in case one of the other two become compromised.

  Because the Navy did not specify soil sampling collection methods in Section 4.3.9 I propose dropping this comment and wait for the procedures. -RT

Table 5-2, Geotechnical Sample Details for Monitoring Well Installation WP, RHSF

- Table 5-2 indicates that laboratory analyses of a material listed as a ~~basalt~~ solid matrix contained in cores will be performed. Please provide ~~the~~ a description of what type of material that the tests specified in this table will be performed on~~specific procedures that will be used to perform analyses on basalt cores in Section 4~~. Providing references to Department of Navy protocols in does not provide a sufficient level of detail.

Table 5-3, Potable Water Sample Details for Monitoring Well Installation WP, RHSF

- The purpose of including Table 5-3 is unclear to the Regulatory Agencies.

  Can we add.

Please provide additional details on the contents of Table 5-3, including sample collection procedures.